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(54) Device for fastening a catheter to a cranial theca for performing an external cerebrospinal fluid drainage.

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## Description

This invention relates to a device for fastening a catheter to a cranial theca for performing cerebro spinal fluids drainage to the outside operations, particularly as practiced in pediatric neurosurgery.

It is known to those skilled in the art of neurosurgery that in order to treat hydrocephalic patients, a catheter is introduced into the patient's cranial theca for effecting draining of cerebro spinal fluid therefrom, and that such cerebro spinal fluid external drainage may have to be extended in time over many weeks under some circumstances.

At present, in pediatric neurosurgery, particularly when operating on child less than three years old, whose cranial theca is thin, it is a current practice to simply insert a catheter into a hole formed in the bone and to retain the catheter in position by passing it through a subcutaneous tunnel.

This system of cerebro spinal fluid external drainage as used in pediatric neurosurgery has great disadvantages particularly in that poor tightness between the catheter and the hole in the cranial theca results in leaking out of cerebro spinal fluid and the risk of severe infections, especially when the drainage to the outside has to be extended in time.

Thus, cerebro spinal fluid fistulae are often produced because of the cutaneous and subcutaneous tissues and the theca bone being thin and dystrophic in nature. US-A- 3,540,451 describes a drainage device according to the preamble of the appended claim 1. However, such device comprises a plurality of parts and is for use with abdominal cavities, i.e. with tissue having a certain degree of elasticity. Such a device could not be used in connection with cranial thecas and should not anyway guarantee a tight seal.

It is an object of this invention to eliminate the above-mentioned disadvantages by providing a device for fastening a proximal, ventricular catheter which can achieve firm securing in place of said catheter, optimal liquid-tight seal at the cranial theca-ventricular catheter junction, as well as permit a cerebro spinal fluid drainage to the outside to be extended in time over many weeks, where necessary.

The fastening device according to the invention as defined in the characterizing portion of claim 1, substantially comprises a tubular body provided at one end with at least one foot consisting of two transverse projections which, when in use, are opposite to one another, and a locking element that can be fitted around the tubular body to cooperate with said transverse foot in firmly locking the tubular body in position.

Said tubular body is a hollow screw having a lumen into which a catheter can be inserted to a desired length; the transverse foot consists of two oppositely arranged tongue portions integral with said hollow screw and orthogonally jutting out with respect to the axis of the screw, while said locking element is a nut taking the form of a concave disc the concavity of which is directed towards the transverse foot.

In order to install the fastening device according to the invention, first an elongated craniectomy is formed into patient's cranial theca with the large dimension of this aperture being smaller than the length of the transverse foot so as to allow the foot to be inserted by a swinging movement thereof. Following to insertion, the axis of the screw is rotated by 90° as a result of which the transverse foot will be oriented in the direction of the small dimension of the elongated craniectomy such that the foot can firmly engage the inside walls of the skull. Then the concave disc is fitted in place by threadingly engaging it around the screw from the outside until the peripheral edge of the disc is brought into close contact with the bone surface, thereby to ensure an optimal tightness condition.

A catheter can be inserted into the lumen of the hollow screw either before or after fitting in place of the screw, by the catheter being gently stretched on a stylet in such a manner that, upon withdrawing of the mandrel, the catheter, which is of a resilient plastics material, will closely adhere to the internal wall of the screw, to thereby ensure tightness.

In order to further increase tightness between the screw inside surface and the catheter, a resilient tubular element can be, again by means of a mandrel, introduced into catheter so that the inserted tubular element will urge the wall of the catheter against the internal surface of the screw. Moreover, a groove is made on the screw and a surgical silk thread tied through the groove.

Providing the transverse foot integral with the screw body has proven to be a most satisfactory solution but it will be understood that a movable foot may also be provided. By way of example, one of the two foot tongue portions may be arranged to be rotatable so that as the screw is being inserted into the elongated craniectomy the rotatable tongue is moved to a position where it is superposed upon the other tongue and thereafter it is rotated to an opposite position thereto. Also, more than one transverse foot may be provided.

The fastening device for catheter according to the invention can also be used in experiments on animals provided with a cranial theca being quite thin in thickness, as well for securing a catheter to other fibrous walls, such for example an abdominal wall.

A device for fastening a catheter according to the invention will now be described in relation to one preferred embodiment thereof, reference being made to the accompanying drawing, in which:

Figure 1 is an axonometric exploded view of a fastening device according to the invention, the figure also showing a portion of cranial theca having an aperture for receiving the foot of the device,

Figure 2 is a median sectional view of the device in figure 1 when in a condition of use.

Referring now to the above figure, a device for fastening a catheter for use in cerebro spinal fluid ventricular external drainage according to this invention, substantially comprises a hollow screw 1 having at one end a foot 2 integrally formed with the screw 1 and consisting of two oppositely arranged tongue portions 3 orthogonally oriented with respect to the axis of screw 1, and a washer means 4 in the form of a concave disc 4 having a threaded central hole 5 whereby the disc 4 can be threadingly engaged on the screw 1 from the opposite end to the foot 2 with the concavity of the disc 4 being directed towards the foot 2.

In order to install the device according to the invention in a cranial theca 6 of a patient, particularly of a child less than three years in age, an elongated aperture 7 is formed in the cranial theca 6 with the small dimension of this aperture 7 being such as to be able to accommodate the foot 2 in a direction of width thereof, while the large dimension of aperture 7 is preferably smaller than the full length of foot 2 but such as to permit the foot 2 to be passed through the aperture 7 by first introducing one tongue portion 3 of the foot and then the other one; this with the purpose of reducing to as small as possible the size of aperture 7 as compared with that of foot 2.

Once the foot 2 has been inserted in the aperture 7, the screw 1 is rotated by 90° so that the foot 2 will be oriented in the direction of small dimension of aperture 7, whereby the foot tongue portions 3 will rest against the internal walls of the cranial theca 6, as clearly shown in figure 2, without said tongue portions 3 being allowed to become released therefrom.

Then, the concave disc 4 is threadingly engaged onto the screw 1 - if necessary, by using a surgical pincer to take hold on two dead holes 8 provided to this end in the convex face of disc 4 - until at least the peripheral edge 9 of disc 4 is brought into close contact with the bone surface, thereby providing a good tightness (see fig. 2).

The proximal, ventricular catheter shown by reference numeral 10 in sectional view figure 2, can be inserted into the lumen 11 of hollow screw 1 either before or following installation of the screw in the cranial theca 6. To this purpose, the catheter

can be gently stretched on a mandrel so that upon withdrawing of the mandrel, the catheter will closely adhere to the internal surface of screw 1 under springback effect of the catheter plastics material. Thus, a good tightness can be obtained.

In order to further increase sealing contact between the internal face of hollow screw 1 and the catheter 1, a tubular resilient element 12 (see figure 2) can be, by means of a second mandrel, introduced into the catheter 10 whereby to urge the catheter 10 against the internal surface of the screw.

Furthermore, a circumferential cut 13 can be made to extend over an arc of 160° on the screw 1 and a surgical silk thread 14 can be tied at the level of this cut, as shown in figure 2, to further increase tightness of the system.

Installation of the fastening device according to the invention for fastening a catheter to a cranial theca of a patient, should be apparent from the sectional view in figure 2 where schematically shown, at 15, is the cerebral matter within the cranial theca 6 and, at 16, the scalp covering the disc 4 after installation; figure 2 clearly shows the good liquid-tight seal which is provided at the cranial theca-ventricular catheter junction.

As a result of this good tightness, the risk of any liquid leaking out can be entirely prevented.

This permits the fluid drawing-off operation to be extended in time over many weeks, where necessary, without any risk of infection or formation of serous fluid fistulae being incurred.

Conveniently, the fastening device according to the invention can be entirely produced from Teflon which is known as a neutral material. However, utilization of such materials as for example carbon fibers or even biopolymer materials is not excluded. Biopolymer materials are known as having a tendency to be penetrated by bone tissue to become amalgamated therewith; thus, when the device of the invention is made from biopolymers it can permanently remain absorbed in the cranial theca by the process of reossification.

While in this disclosure the foot 2 is described as being integral with the screw 1, it is to be understood that the foot 2 could be designed in other ways. Thus, according to an advantageous embodiment, one of the tongue portion 3 is integral with the screw 1 while the other is arranged to be rotatable around the screw 1, in such a manner that, before the foot 2 is inserted into the aperture 7, this rotatable tongue 3 can be moved to a position where it is superposed on the fixed tongue and, thereafter, to a position opposite to said fixed tongue. This permits the aperture 7 to be further reduced in size.

Likewise, there may be more than one foot 2 and, for example, two feet 2 may be provided so

that one of them is rotatable and can be rotated to a position where it is either superposed upon the other foot or placed orthogonally thereto.

Also, it is to be emphasized that although the fastening device of the invention is particularly intended for use in pediatric neurosurgery operations, it could be utilized as well in experimental work on animals, particularly animals having a cranial theca rather thin in thickness, for drawing-off cerebrospinal fluid, or making drug infusions, or the like.

Again, the method of fastening catheters according to the invention can be applied for securing catheters to fibrous walls, such as abdominal walls.

While the invention has been particularly described hereinabove and shown in the accompanying drawing in relation to a specific embodiment thereof, it is to be understood that many changes may be made to the details of construction without departing from the scope of the invention as defined in the appended claims.

Moreover, it must be emphasized that the invention herein described works actually as an access to the cerebro spinal fluid spaces. Therefore, the described device is a tool suitable for any perfusion and installation or drainage to the outside of any possible fluid containing medications.

#### Claims

1. A device for fastening a catheter to a fibrous wall comprising a tubular body (1) in the form of a hollow screw having a lumen (11) for receiving a catheter (10), at least a transverse foot (2) provided at one end of the hollow screw (1) and apt to be received and blocked in place in an aperture (7) in the cranial theca (6), and a locking means (4) threadingly engaged on the screw (1) in opposite relationship with the foot (2) so as to bear on the outer surface of the cranial theca (6), characterized in that the fibrous wall is a cranial theca (6), the catheter being particularly for use for ventricular cerebro spinal fluid drainage to the outside in pediatric neurosurgery, in that said foot (2) consists of two opposite tongue portions (3) orthogonally jutting out with respect to the axis of the screw (1), and in that said locking means (4) is a nut in the form of a concave disc the concavity of which is directed towards the foot (2) for a liquid-tight contact with the cranial theca.
2. The device according to claim 1, wherein two diametrically opposite dead holes (8) are provided on the convex surface of disc (4) and permit the disc (4) to be engaged and disengaged by the aid of a surgical pincer.

3. The device according to claim 1 or 2, wherein said tongue portions (3) are integral with the screw (1).
4. The device according to claim 1 or 2, wherein at least one of said tongue portions is arranged to be movable with respect to the screw (1).
5. The device according to claim 1, wherein said aperture (7) is an elongated aperture, the small dimension of which is at least the same as the width of the foot (2) and the large dimension of which is preferably smaller than the overall length of foot (2).
6. The device according to any preceding claims, wherein the screw (1) is provided with a circumferential cut (13) extending over an arc of about 160° permitting the catheter (10) to be tied by means of a surgical silk thread (14).
7. The device according to any preceding claims, wherein a tubular resilient element (12) is provided for insertion into the inside of catheter (10) in order to urge this latter against the internal wall of the tubular body (1).
8. The device according to any preceding claims, wherein the device is made from Teflon, carbon fibers or biopolymer materials or combinations thereof.

#### Patentansprüche

1. Vorrichtung zum Befestigen eines Katheters an einer Faserwand, die umfaßt einen rohrförmigen Körper (1) in Form einer Hohl-Schraube mit einem Innenraum (11) für die Aufnahme eines Katheters (10), mindestens einen Transversalfuß (2), der an einem Ende der hohlen Schraube (1) vorgesehen ist und in einer Öffnung (7) in einer Kranial-Theca aufgenommen und an Ort und Stelle fixiert werden kann, und eine Befestigungseinrichtung (4), die auf die Schraube (1) so aufgeschraubt werden kann, daß sie dem Fuß (2) gegenüberliegt, so daß sie sich auf die äußere Oberfläche der Kranial-Theca (6) erstreckt, dadurch gekennzeichnet, daß die Faserwand eine Kranial-Theca (6) ist, wobei der Katheter insbesondere vorgesehen ist für die Verwendung der Ableitung der Ventrikel-Cerebrospinal-Flüssigkeit nach außen in der pädiatrischen Neurochirurgie, daß der Fuß (2) aus zwei entgegengesetzten Laschenteilen (3) besteht, die orthogonal nach außen vorspringen, bezogen auf die Achse der Schraube (1), und daß die Befestigungseinrichtung (4) eine Mutter in Form einer konkaven

Scheibe ist, deren Konkavität in Richtung auf den Fuß (2) gerichtet ist zur Herstellung eines flüssigkeitsdichten Kontakts gegenüber der Hirn-Schutzhülle.

2. Vorrichtung nach Anspruch 1, in der zwei diametral einander gegenüberliegende blinde Löcher (8) auf der konvexen Oberfläche der Scheibe (4) vorgesehen sind, die das Einsetzen und Herausnehmen der Scheibe (4) mit Hilfe einer chirurgischen Pinzette erlauben.

3. Vorrichtung nach Anspruch 1 oder 2, in der die Laschenteile (3) mit der Schraube (1) eine Einheit bilden.

4. Vorrichtung nach Anspruch 1 oder 2, in der mindestens einer der Laschenteile so angeordnet ist, daß er in bezug auf die Schraube (1) beweglich ist.

5. Vorrichtung nach Anspruch 1, in der die Öffnung (7) eine längliche Öffnung ist, deren kleiner Durchmesser mindestens gleich der Breite des Fußes (2) ist und deren großer Durchmesser vorzugsweise kleiner ist als die Gesamtlänge des Fußes (2).

6. Vorrichtung nach irgendeinem der vorhergehenden Ansprüche, in der die Schraube (1) mit einem Einschnitt (13) auf dem Umfang derselben versehen ist, der sich über einen Bogen von etwa 160° erstreckt, der die Befestigung des Katheters (10) mittels eines chirurgischen Seidenfadens (14) erlaubt.

7. Vorrichtung nach irgendeinem der vorhergehenden Ansprüche, in der ein rohrförmiges elastisches Element (12) vorgesehen ist für das Einsetzen in das Innere des Katheters (10), um letzteren gegen die Innenwand des rohrförmigen Körpers (1) zu drücken.

8. Vorrichtung nach irgendeinem der vorhergehenden Ansprüche, die aus Teflon, Kohlefaser oder Biopolymermaterialien oder Kombinationen davon hergestellt ist.

#### Revendications

1. Dispositif de fixation d'un cathéter sur une paroi fibreuse, comprenant  
un corps tubulaire (1) en forme de vis creuse où est ménagé un passage (11) de réception d'un cathéter (10),  
au moins un pied transversal (2) disposé à une extrémité de la vis creuse (1) et apte à être reçu et bloqué en place dans une ouvertu-

re (7) ménagée dans la boîte crânienne (6), et un moyen de verrouillage (4) vissé sur la vis (1) en relation d'opposition avec le pied (2) de façon à s'appuyer sur la surface extérieure de la boîte crânienne (6),

caractérisé en ce que

la paroi fibreuse est une boîte crânienne (6), le cathéter étant à utiliser particulièrement pour un drainage de fluide cérébro-spinal ventriculaire, vers l'extérieur, dans une neurochirurgie pédiatrique,

en ce que ledit pied (2) consiste en deux parties opposées (3) formant des languettes en saillie orthogonale par rapport à l'axe de la vis (1), et

en ce que ledit moyen de verrouillage (4) est un écrou en forme de disque concave dont la concavité est dirigée vers le pied (2) pour réaliser avec la boîte crânienne un contact étanche aux liquides.

2. Dispositif selon la revendication 1, dans lequel deux trous borgnes diamétralement opposés (8) sont ménagés sur la surface convexe du disque (4) et permettent d'engager et de dégager le disque (4), à l'aide d'une pince chirurgicale.

3. Dispositif selon la revendication 1 ou 2, dans lequel lesdites parties (3) formant des languettes sont d'un seul tenant avec la vis (1).

4. Dispositif selon la revendication 1 ou 2, dans lequel au moins l'une desdites parties formant des languettes est agencée de manière à être mobile par rapport à la vis (1)

5. Dispositif selon la revendication 1, dans lequel ladite ouverture (7) est une ouverture allongée dont la petite dimension est au moins égale à la largeur du pied (2) et dont la grande dimension est de préférence plus petite que la longueur totale du pied (2).

6. Dispositif selon l'une quelconque des revendications précédentes, dans lequel il est ménagé, dans la vis (1), une découpe circconférentielle (13) s'étendant sur un arc d'environ 160° et permettant de lier le cathéter (10) à l'aide d'un fil de soie chirurgical (14).

7. Dispositif selon l'une quelconque des revendications précédentes, dans lequel un élément tubulaire élastique (12) est disposé de manière à être inséré dans l'intérieur du cathéter (10) afin de pousser ce dernier contre la paroi interne du corps tubulaire (1).

8. Dispositif selon une revendication précédente quelconque, dans lequel le dispositif est en "TEFLON", en fibres de carbone ou en matières biopolymères ou en une combinaison de ces matériaux.

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